

11.1 - Solution Composition

New formulas you need to know :

★ **mole fraction:** $X_A = \frac{n_A}{n_A + n_B}$

-this formula shows the mole fraction of compound A dissolved in the solvent compound B

-Ex. if we have 1 mol of compound A and its dissolved in 3 moles of compound B

Total moles = 1 mol + 3 moles = 4 moles

$$X_A = 1 \text{ mol A} / 4 \text{ moles} = 0.25$$

★ **molality:** $m = \frac{\text{moles of solute}}{\text{kilograms of H}_2\text{O}}$
units : mol/kg

Let's try an example :

A solution is prepared by mixing 1.00 g ethanol ($\text{C}_2\text{H}_5\text{OH}$) with 100.0 g water to give a final volume of 101 mL. Calculate the molarity, mole fraction, and molality of ethanol in this solution.

Let's try another example :

The electrolyte in lead batteries is a 3.75 M sulfuric acid solution that has a density of 1.230 g/mL. Calc mass %, molality and normality.

11.2 - Energies of Solution Formation

Review :

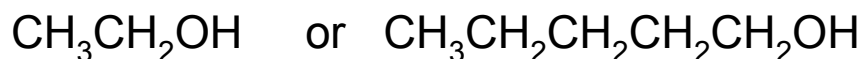


Like Dissolves Like

Ex. 1 - Oil will dissolve best in a non-polar solvent since it is non-polar. Therefore, when it combines with vinegar, which is polar, we get a mixture with 2 layers.

Can you suggest an appropriate solvent for oil?

Ex. 2 - What will dissolve better in water and explain why:



The formation of a solution involves:

1. Breaking up the solute into its individual components
->expanding the solute

Ex. $\text{NaCl}_{(s)}$ ->

* here the ionic forces that hold NaCl in a crystal form must be overcome

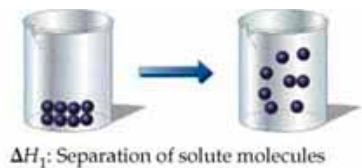
2. Overcoming intermolecular forces in the solvent to make room for the solute -> expanding the solvent

Ex. For $\text{H}_2\text{O}_{(l)}$, to expand the solvent the hydrogen bonds must be broken

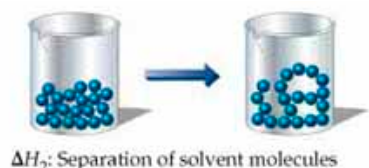
3. Allowing the solute and solvent to interact to form the solution

Ex. When NaCl dissolves in $\text{H}_2\text{O}_{(l)}$ and becomes aqueous, there are strong interactions between H_2O molecules and the ions

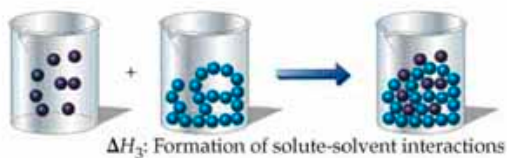
Solution Formation



① expanding the solute



② expanding the solvent



③ forming solute-solvent interactions

The enthalpy (heat of reaction) change for the formation of a solution is given by

$$\Delta H_{\text{solution}}$$

Homework!

Pg. 548-549 #25,29,31,37,41

For question 31, you do not have to find normality